April 1950 E-799

United States Department of Agriculture
Agricultural Research Administration
Bureau of Entomology and Plant Quarantine

THE SPRING TIPHIA, AN IMPORTED ENEMY OF THE JAPANESE BEETLE

By J. L. King and L. B. Parker,
Division of Fruit Insect Investigations

The Japanese beetle (Popillia japonica Newm.), an accidently introduced insect, entered this country free from its insect enemies and other factors that control it in its native land. This fact was quickly recognized and led to the early study of its natural enemies in Japan. Work in Japan, begun in 1920, soon led to the discovery of five insect species that prey on Japanese beetle grubs. These parasites have all been established in the United States, but as might be expected, with varying degrees of success. The most efficient of these introduced species is the spring Tiphia (Tiphia vernalis Roh.).

What Is the Spring Tiphia Like?

At first glance the spring Tiphia may be thought to be a large, black, winged ant (fig. 1), but it is actually a small wasp. These wasps do not

Figure 1.--Spring Tiphia, enlarged.

live in nests or swarms, as do many of the more commonly known species, but are solitary throughout their lives. The female, which is approximately half an inch long, possesses a small sting with which it attacks the grub of the Japanese beetle, but is no more dangerous to humans than a horse fly, and much less likely to be encountered. The male is about three-eighths of an inch long and has no sting.

The Life Cycle of Tiphia

The adult Tiphia wasps emerge from their cocoons in the soil in May and June. In the Philadelphia area they are active between May 1 and June 15. Males begin to appear about a week ahead of the females. During a brief period of mating and feeding, both sexes may be seen alighting on the leaves of smooth-leafed trees or shrubs, in search of the minute droplets of sweet honeydew left by plant lice. Then the female Tiphia wasps start digging in the soil in search of beetle grubs on which to lay their eggs. They find their prey in the soil through a keen sense of smell.

When a female Tiphia locates a grub she attacks it. This results in a struggle, which is quickly ended when the parasite wraps herself around the grub and stings it, causing a paralysis that lasts about 30 minutes. While the grub is paralyzed the Tiphia lays a single egg on its under side, just behind its third pair of legs. The female Tiphia lives for about a month, and may lay 40 or 50 eggs on as many different grubs.

The Tiphia egg hatches in about 7 days into a tiny, maggot-like larva, which remains attached to the beetle grub as it feeds and moves through the soil (fig. 2). The grub, weakened by the loss of blood which the Tiphia larva sucks out to support its own rapid growth, soon stops feeding and moving through the soil. While feeding on the beetle grub the young parasite grows very rapidly and attains full size within a few days. By this time the grub has been entirely consumed, except for its head shell (fig. 3). The full-grown Tiphia larva then spins a strong, water-tight, silken cocoon within the earthen cell formerly occupied by the beetle grub.

The spring Tiphia transforms into an adult wasp within its cocoon late in the summer or early in the fall, but remains in the ground until the following spring. Then it chews its way out of the cocoon and emerges from the soil to start the life cycle over again.

Since the Tiphia does not attack any other prey than the Japanese beetle grub on which its young develops, and since the adult wasp feeds only on honey dew and similar sweet fluids found on plants, it can never become a pest.

Figure 2. --Tiphia larva attached to Japanese beetle grub.

Figure 3. --Tiphia larva almost fully grown.

How Much Good Does the Spring Tiphia Do?

The spring Tiphia is one of several natural factors that play a part in the control of the Japanese beetle. Each Tiphia, either male or female, develops at the expense of a Japanese beetle grub. An exact measure of the good done by the spring Tiphia is difficult, because of its hidden, underground activities. Surveys have been made in areas where the spring Tiphia has been established long enough to give some idea of its value in lessening the Japanese beetle population. These surveys consist of digging and sifting the soil in a given number of square feet, to collect all stages of beetle and parasite that are present. To give a true idea of the effectiveness of the parasite the survey must be made between the time the adult Tiphia wasps complete their egg laying and the time the Japanese beetle appears above ground.

Between the years 1935 and 1949 thirteen such surveys were made. The localities included in the surveys, the type of area sampled, the number of samples per area, and the results obtained are shown in table 1.

The Rushland surveys were made when grubs were abundant in a small pasture. The colony in this pasture was started with 356 female Tiphia parasites 4 years before the first survey. These surveys showed a normal fluctation in numbers of parasites.

Table 1.--Effectiveness of spring Tiphia in reducing Japanese beetle populations in surveyed plots

Locality	Year	1-square-foot samples	Grubs	
			Per square foot	Parasitized
		Number	Number	Percent
Pasture:				
Rushland, Pa.	1935	200	5.7	61
	1936	200	4.1	47
	1939	200	5.3	48
Golf course:				
Philmont, Pa.	1936	200	5.7	58
	1947	40	3.7	42
Overbrook, Pa.	1937	565	.9	36
Wilmington, Del.	1947	40	1.5	47
York, Pa.	1947	40	2.5	43
Valley Forge, Pa.	1949	40	5.8	30
Gulf Mills, Pa.	1949	40	5.3	31
Spring Mills, Pa.	1949	40	4.9	47
Burlington, N.J.	1949	40	2.8	49
Hospital grounds:				
Phoenixville, Pa.	1949	40	3.9	19

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The Philmont survey in 1936 also covered a period of high grub abundance. The survey was made 9 years after the colony was started in 1927 with the liberation of 1,170 female parasites. However, between 1931 and 1936 a total of 34,240 females had been collected from that area for redistribution in other States. The same area, when surveyed in 1947 showed a drop in grub population, although between 1936 and 1947 an additional 40,426 females had been collected there.

In the Overbrook survey the number of samples (565) was the largest ever taken in one survey. It was made 8 years after the initial liberation, and followed a period when both hosts and parasites were abundant. Here the beetle population was notably decreased, as shown in table 1.

The 1949 surveys were made following a period of extreme drought and there is little doubt that the parasite's efficiency was impared by the difficulty the female Tiphia experienced in entering the hardened soil.

The data obtained in the Phoenixville survey show that the spring Tiphia finds its way into host-infested areas where no liberations have been made. This turf area, approximately 6 years old, is 2 miles

http://archive.org/details/iphiaimpo00unit

The briefness of the period (about 7 to 10 days each year) during which reliable surveys can be conducted prevents extensive studies of this nature in any one year. However, the results of the surveys that have been made, and the very large numbers of Tiphia adults often seen during the flight period, suggest that this parasite may be of much greater benefit than is usually thought.

Where Can Tiphia Wasps Be Used?

The spring Tiphia is believed to contribute enough to the natural control of the Japanese beetle to be worthy of colonization at all points in the infested area where it is not present. Although natural controls are constantly expanding, their spread generally lags several years behind that of the beetle. Colonization accelerates their establishment in the newer infested areas.

It is desirable to provide freshly liberated colony units of Tiphia with all possible advantages in order to assure establishment in the new area. Therefore, colony sites that offer favorable habitats of a permanent nature, together with adequate grub populations, are chosen, as far as possible. Desirable terrain for initial colony establishment is represented by golf courses, parks, cemeteries, estates, and pastures, when a degree of permanence is assured. In such situations not only the type of turf most suitable for the Japanese beetle grubs but also shaded foliage, upon which the adult Tiphia wasps find their food, are usually present and make possible a thriving colony from which the parasites can spread into surrounding areas.

The practice of selecting such areas for initial colonization may have led to the erroneous belief that the parasites are too selective as to habitat and will not spread into less suitable agricultural areas. Surveys of intervening terrain, made after sufficient time had elapsed for the original colonies to have developed volume, show that Tiphia wasps are found in varying abundance when such areas are also favorable for the grubs.

A total of 1983 colonies of Tiphia vernalis have been liberated by Federal Government through 1949. It has been possible to scout 45 percent of the colony sites and the parasite has been recovered at 67 percent of those scouted. Some of the surveys have been made only for brief periods and under unfavorable weather conditions. Further surveys with better weather would undoubtedly show that the parasites are present at more of the sites.

This parasite has been placed over a wide area extending from New Hampshire to Virginia and westward to Ohio. Recoveries have been made from the extremes of this distribution, but there has not been sufficient opportunity to study the parasite's abundance and adaptability in the northern areas.

Soil types also enter into the problem of distribution of the spring Tiphia and apparently it prefers the heavier soils to the sandy areas of New Jersey and some parts of Maryland.

Colonization of Tiphia should not be regarded as a substitute for the use of milky disease or insecticides. The parasite helps to lower the general level of the beetle population in an infested area. Tiphia and other natural controls working together have been known to become so effective that other large-scale control measures are no longer necessary.

How are Tiphia Colonies Distributed?

The distribution, or colonization program, is accomplished in large part through cooperation between the Bureau of Entomology and Plant Quarantine and the State experiment stations or departments of agriculture. These agencies determine the needs of their respective States, and the Tiphia material is provided for their distribution in newly infested areas. Some parasite-colonization work in the area of general infestation is still carried on by the Bureau of Entomology and Plant Quarantine. This work supplements the Federal-State cooperative program, and attempts to maintain a more uniform coverage of newly infested areas that develop. Distribution of Tiphia parasite colonies is not made to individuals.

Collection and Liberation of Tiphia

After appraisal scouting has indicated the locations where Tiphia are most abundant, the process of collecting females is begun. To attract these parasites in large numbers within reach of the collectors a 10-percent honey solution is sprayed onto the leaves of low shrubs and tree branches. Broad, smooth leaves, such as those of the Norway maple, are best for this purpose, as the parasites are easier to see and to collect from large leaves than from very small ones. The females are picked from the foliage with the fingers, as this method is faster and less cumbersome than using a net, although some experience is usually necessary before a collector is proficient.

The female Tiphia occasionally administers a slight sting, which is more annoying to some people than to others, but in no case is it serious, and as a collector gains experience he is able to avoid frequent stings.

As the females are picked from the leaves they are placed in specially designed cans, 100 individuals per can, from which they are later released at the desired point of colonization. The cans, which are about 10 by 6 inches, contain sufficient damp peat to provide a medium into which the Tiphia can burrow. Each can also contains a

bottle of water with a wick leading into an absorbent plug, from which the wasp may obtain water. Food in the form of a honey fondant is packed into holes in a wooden block. The lid is provided with screened ventilation holes and a central hole through which the parasites are placed in the can as they are collected. A 2-inch sleeve projects into the can, to prevent escape of the wasps whenever the cork is removed during use.

When a can has received 100 females (the conventional colonization unit) the collector places it in a cool, shady place and continues with a fresh can.

The method of handling here described has been found very convenient, since the cans can be held in cool storage and shipped by common carrier, or otherwise transported, to the colonization point without further handling of the insects.

Releasement consists merely in emptying the colonization unit at a suitable location where a number of host grubs are present in the turf.

How Do Other Control Methods Affect *Tiphia*?

The treatment of soil with any of the recently developed and highly toxic insecticides is detrimental to *Tiphia* adults emerging from it. However, such treatment will not exterminate them if they are well established in the area, because in most localities, the areas that are chemically treated to kill Japanese beetle grubs constitute a small part of the beetle-infested terrain. The adjacent untreated infested soil harbors grubs upon which *Tiphia* will continue to develop.

The organisms that cause the milky disease of Japanese beetle grubs infect some grubs that are parasitized by *Tiphia*; but, since the disease is harmless to the parasite, its only detrimental effect on the parasite is to kill the beetle grub before the *Tiphia* larva can complete its growth. Although this sometimes happens, the spring *Tiphia* develops before the soil temperatures are high enough to enable the milky disease to reach its most destructive period.

Experience with both milky disease and the spring *Tiphia* in the field has shown that these two natural control factors can be used successfully in the same area.

The Present Distribution of Spring *Tiphia* Colonies

When *Tiphia* parasites are distributed in newly infested areas, they are usually liberated in colonies of 100 females. The distribution of colony units of the spring *Tiphia*, by States and counties, through 1949 is shown in the following tabulation.

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State	Number of Counties	Number of Colonies
Pennsylvania	21	532
Maryland	18	392
New Jersey	18	358
New York	22	265
Connecticut	6	151
Virginia	14	141
Delaware	2	60
Rhode Island	4	25
Ohio	5	27
Massachusetts	5	16
District of Columbia	1	9
New Hampshire	3	3
North Carolina	2	2
West Virginia	1	2
Total	122	1,983